

# Earth Home™

Self Sufficient Integrated Housing System for  
Sustainable Community Development

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## Sustainable Design Group

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# Cost of modern technology

- “Modern” technology has brought many improvements to the economy and peoples lives, but at a cost.
  - Dependence on imports for basic life support and economic development
  - Subject to rising cost of imports
  - Environmental degradation
  - Vulnerability
  - Disconnect from nature

# We are at the Tipping Point

- Central oil and coal based energy is an obsolete 100+ year old technology who's time has past
- It is too expensive in terms of dollars, social and environmental impact and peoples lives
- Its controlled by people who don't like us
- Its killing us and the planet
- Its running out

# The Turning Point

- Time to regain control
- Renewable is the way of the future and it is available today
- Efficiency, wind, solar and biomass energy is cheaper than oil today !

# Maryland Clean Energy Economic Development Potential Study

One year long study funded by DBED, MEA and Abell Foundation

The study examined the

- Past and future energy use profile in Maryland,
- Renewable and energy efficiency resource potential,
- Domestic and international clean energy policies,
- Economic impacts of energy efficiency and developing the State's renewable energy resources.

# Clean Energy Development Study Findings

- The Clean Energy industry is a **\$50 billion** a year industry world wide, growing at a rate of **30% per year** and one of the hottest investment opportunities on Wall Street today.
- A growing number of States are investing aggressively in the Clean Energy industry (over **\$500 million per year**). Maryland, however, is lagging in this sector and is missing out on huge economic development and job growth potentials that the other States are realizing.

# Clean Energy Development Study Findings

- Maryland has vast untapped renewable energy resources that could produce from 30% to 137% of all the States electricity from solar photovoltaics and on-shore and off-shore wind power at costs often competitive with conventional sources.



# Clean Energy Development Study Findings

- Energy efficiency can significantly reduce energy costs to homeowners, businesses, institutions and government at a cost **60%-70% cheaper** than new generating capacity in Maryland.
- Ethanol can be produced in Maryland at a **price competitive with today's gasoline prices**



# Clean Energy Development Study Findings

- Given Maryland's excellent research laboratories and expertise in biotechnology, it is in an excellent position to become a leader in biofuels research and development.
- However, Maryland seems to be moving in the opposite direction by cutting the already slim funding for the Maryland Energy Administration by over 67% in the past two years. (\$3.96 million in 2004 to \$1.29 million in 2006)

# Clean Energy Development Study

## Findings

- Over the next 20 years, at the lowest level of effort (20% energy-efficiency improvement, 10% renewable-energy increase, and 10% ethanol production increase), **144,000 jobs will be created** (67,000 in Baltimore), **wages & salaries will go up by \$5.7 billion** (\$2.4 billion in Baltimore); **state & local tax revenues will increase by \$973 million** (\$412 million in Baltimore); and gross state product (**GSP**) **will increase by \$16 billion** (\$7 billion in Baltimore).
- At the highest level of effort (40% energy-efficiency improvement, 30% renewable-energy increase, and 30% ethanol production increase), **the economic impacts more than double.**

# Clean Energy Development Study Recommendations

## **Maryland Clean Energy Center (MCEC)**

- The MCEC is modeled after the leading successful clean energy business development programs in the country with the mission to promote economic development in the clean energy sector by improving access to energy efficiency and renewable energy technologies and supporting the growth of clean energy businesses in Maryland.
- MCEC is a public /private partnership that brings together the diverse interests in the clean energy sector as a clearly defined business sector in Maryland and a forum for discussions about strategies and policies that will support the growth of the clean energy sector.

# Sustainable Development

The technology exists to make homes and communities self sufficient based on renewable resources and local materials.

In many parts of the world, it is the most economic solution.

# Opportunity

- The world is blessed with all the resources it needs to grow and prosper in harmony with nature
  - Solar for power and hot water
  - Wind for power
  - Biomass for fuel
  - Abundant local building material- dirt

# Earth Home <sup>TM</sup>

Self sufficient, survivable, affordable housing.

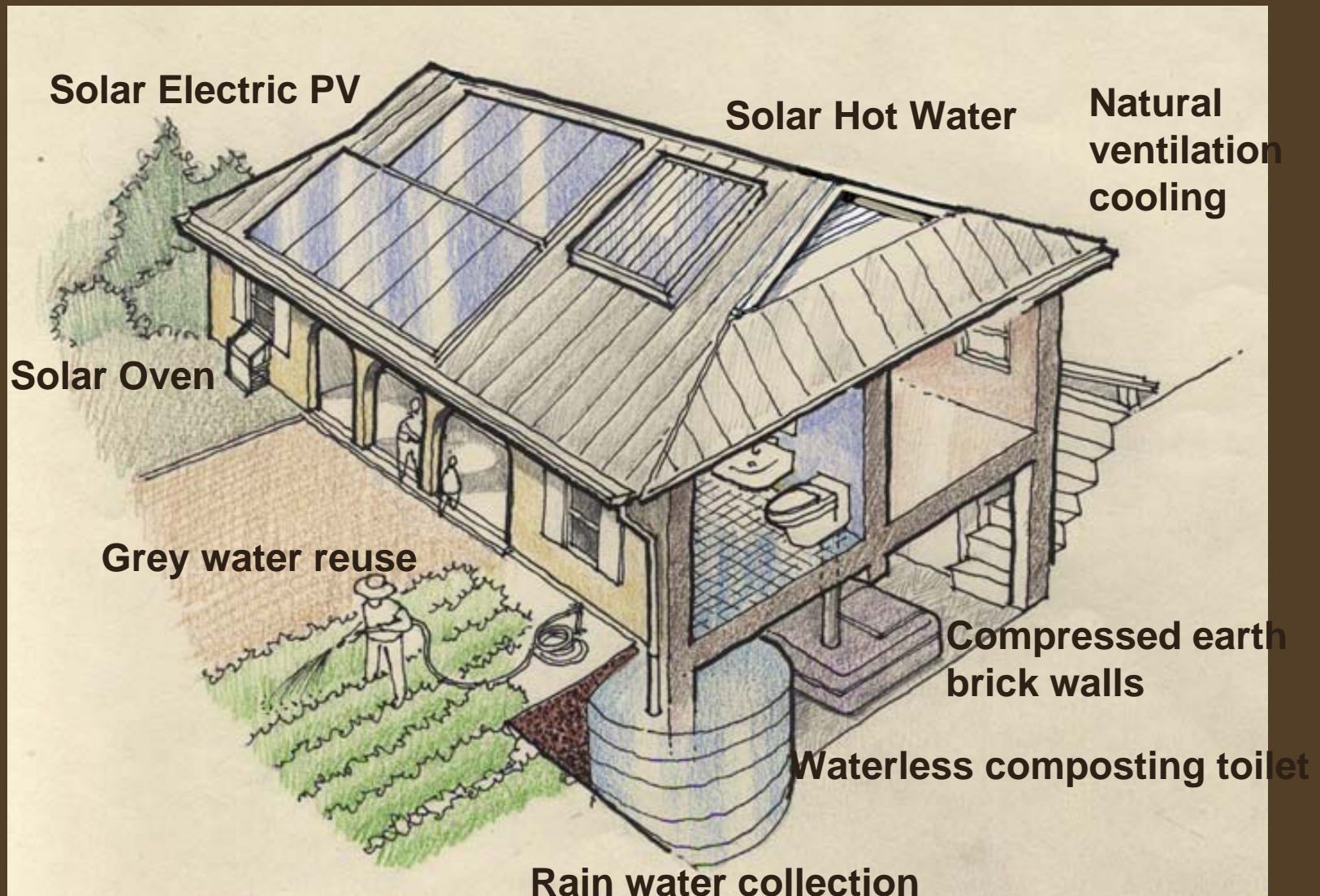
**Earth Home <sup>TM</sup>** is a fully integrated building system, using local materials to meet all the life support needs of the occupants for electricity, water, sanitary waste, hot water, cooking and comfort, without the need for central power, water or sewer and can survive most natural disasters.

# *What a Home Should Provide*

- Comfortable, pleasing environment
- Healthy environment
- Durability and safety from hurricanes, fire, insects and rot
- Not harm Nature
- Affordable/ economical
- Clean water
- Sanitary waste processing- toilets and waste water
- Electricity
- Hot water
- Cooking

# Earth Home <sup>TM</sup>

Self Sufficient Integrated Housing System for the Caribbean





# Earth Home <sup>TM</sup>

Self sufficient, survivable, affordable housing

- Power- PV
- Hot Water- solar
- Water- Rain water Cistern
- Waste processing- Composting toilet and kitchen waste
- Solar Cooking
- Natural Cooling
- Built with local materials- earth bricks
- Water filter/purification
- Overhangs for shade
- Porch for outside living
- Cathedral ceiling
- High operable windows in gables
- Ceiling fans
- Affordable



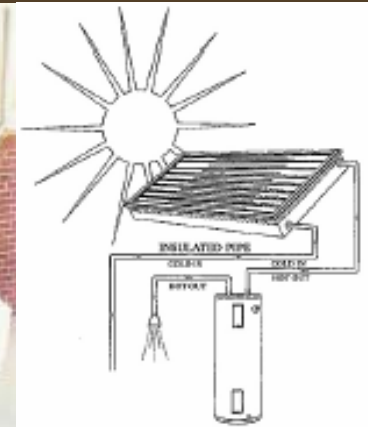
# Earth Home <sup>TM</sup> Technologies



**Compressed Earth Brick from Local Soil**



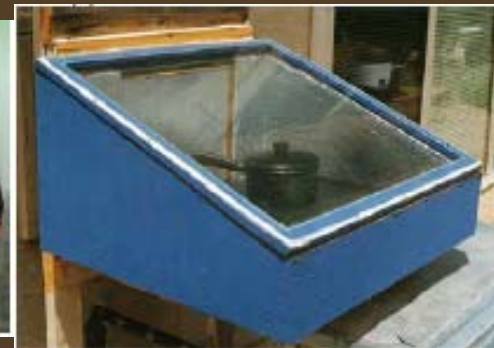
**Composting Toilet**



**Solar Hot Water**



**Solar Power System**



**Solar Wall Oven**

# Photovoltaic or PV Power

Using the sun to generate electricity

Photovoltaic (PV) systems convert sunlight directly into electricity, and are potentially one of the most useful of the renewable energy technologies.





# PV System Components



PV Panels

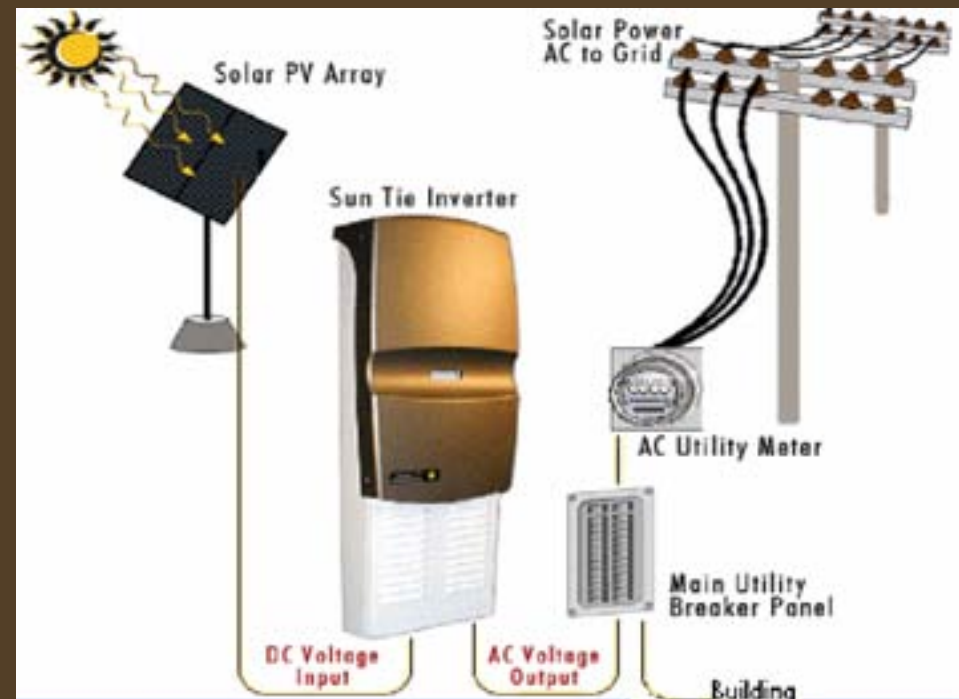


Inverter and  
Charge  
controller

Batteries

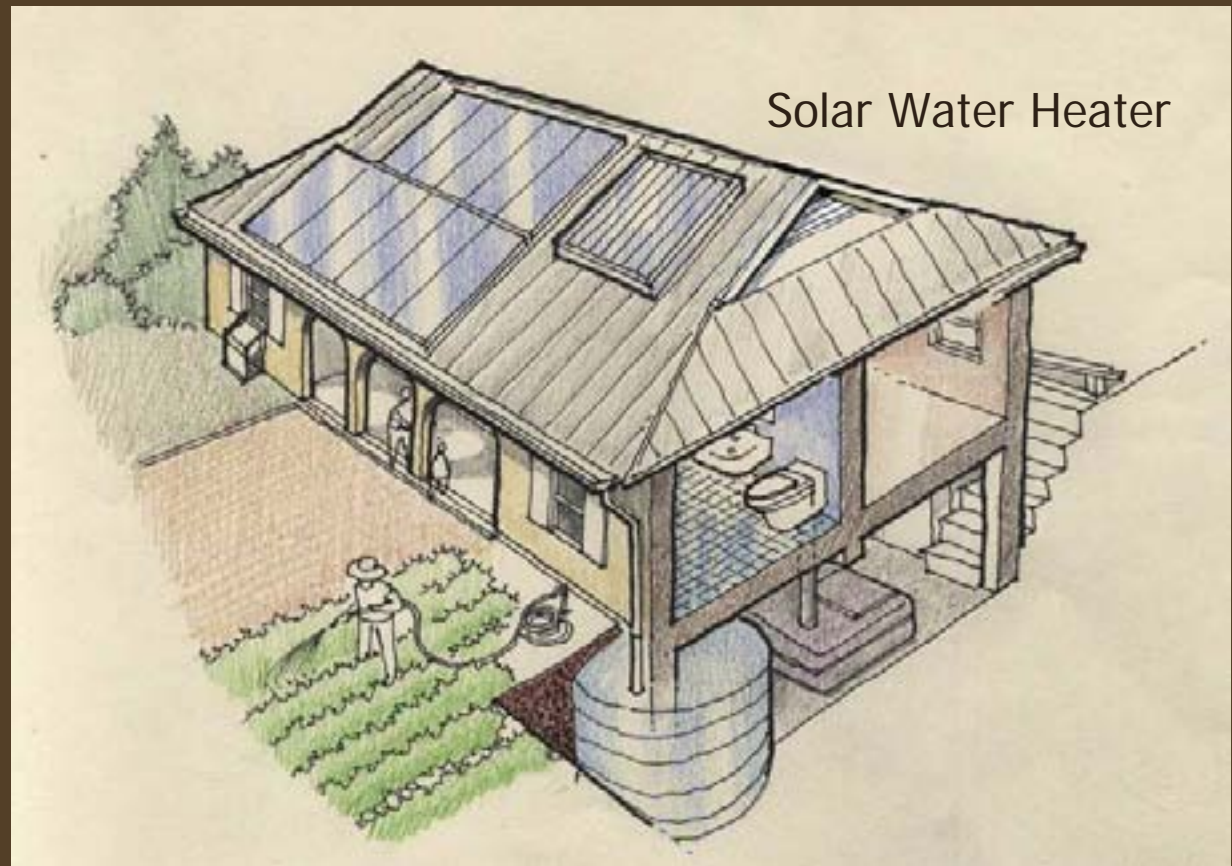
# PV Systems

- Grid Tied
  - Feeds excess solar power to grid
  - Does not work if grid is down
  - No batteries
  - Lowest cost
- Back up Power System
  - Grid interactive
  - Batteries provide power if grid goes down
- Stand Alone
  - No Grid connection
  - Full battery powered
  - Back up generator required

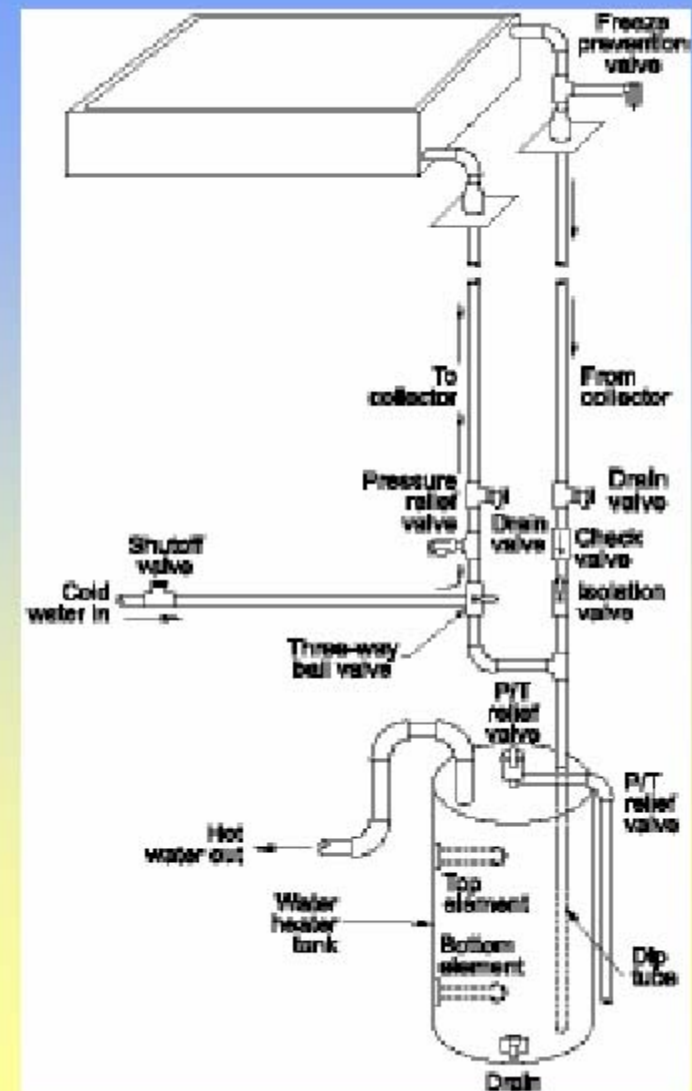
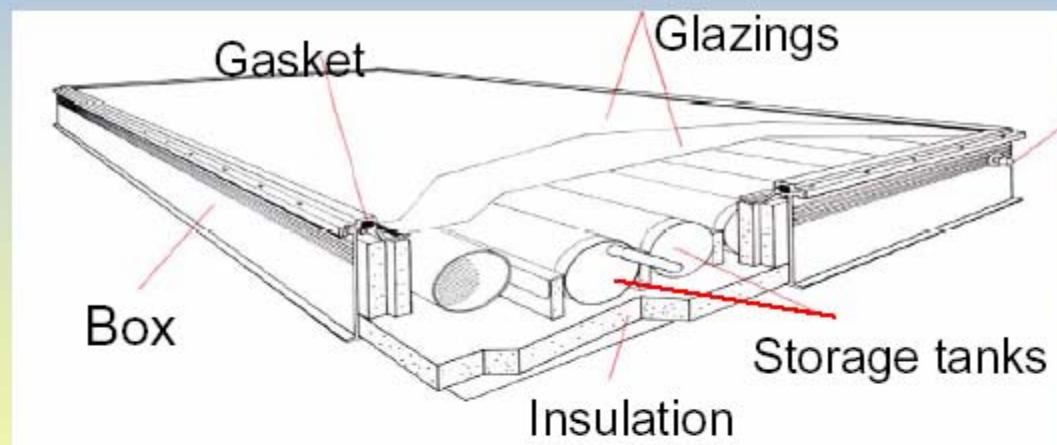


# Solar Water Heater

- Solar water heaters are the most practical and popular use of solar energy in the world
- Systems are readily available and reliable
- Excellent pay-back



## Integral Collector-Storage (ICS) System



# Waste Water Systems

- “Waste” water is not wasted
- Water from sinks, shower and washing machine is used to irrigate the garden

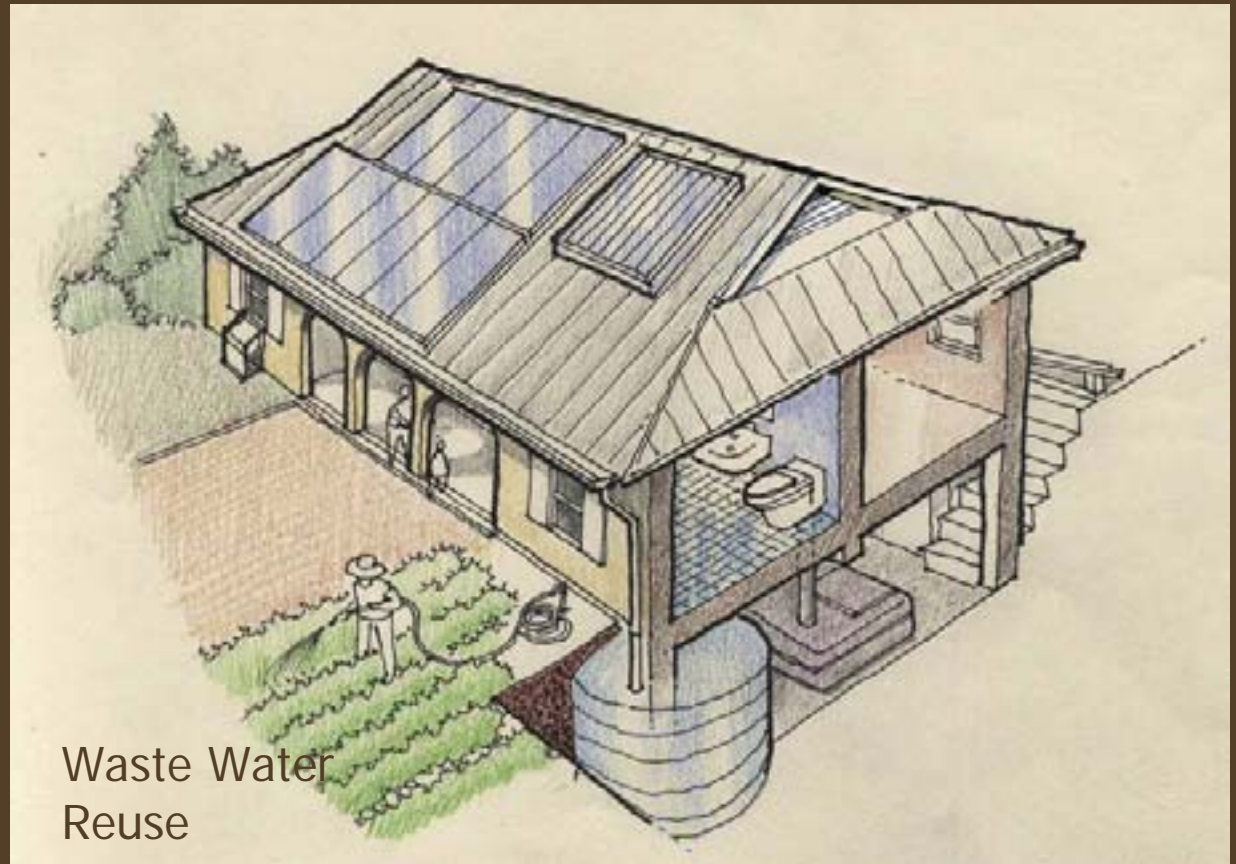




FIGURE 2: BRANCHED DRAIN TO MULCH BASINS (ELEVATION)

**Double ell access chamber**

empty 1 gal plastic pot covered with stepping stones allows access to double ell for cleaning without knocking dirt or leaves in (the most common way to disturb the flow)

**Double ell**

Should sit on brick for easy leveling

**Access covers**

**Outlet access chamber**

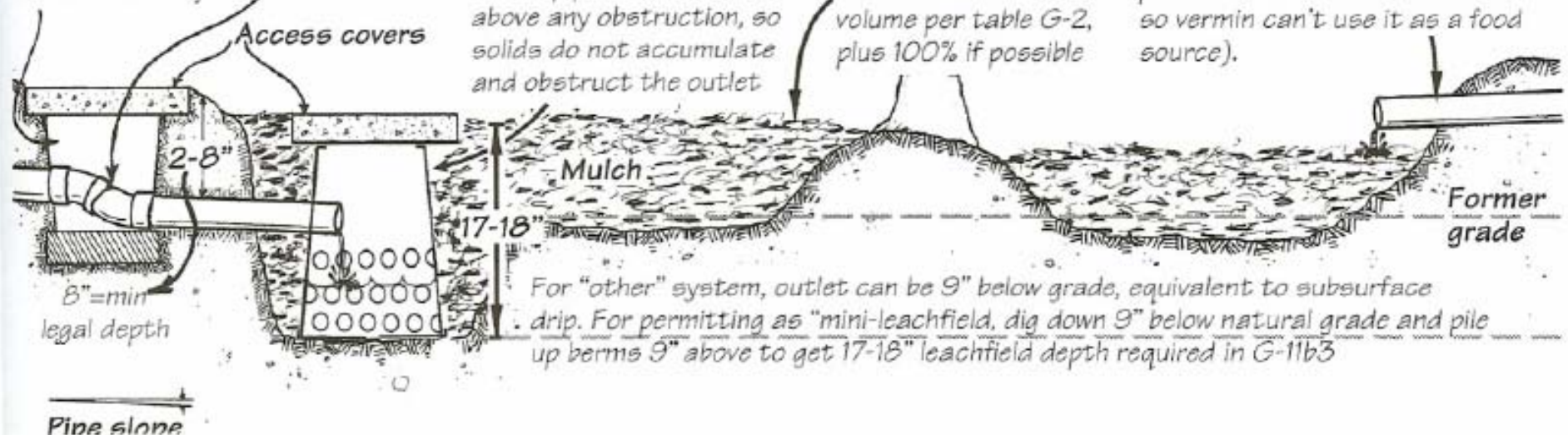
infiltrator<sup>27</sup>, plastic drum cut in half lengthwise, or upside-down, empty 5 gal plastic pot with bottom cut out and holes drilled in the sides. Allows solids out into mulch for biodegradation so clogging does not occur. It is very important that discharge end of pipe is 2" or more above any obstruction, so solids do not accumulate and obstruct the outlet

**Surface outlet option**

(Branched drain to mulch basins) If subsurface distribution is not required, as in Arizona and New Mexico, GW can be discharged 2" above surface of mulch, into which it quickly disappears. This is much simpler to construct and maintain. The added health risk is minimal (subsurface distribution is preferred for kitchen sink water so vermin can't use it as a food source).

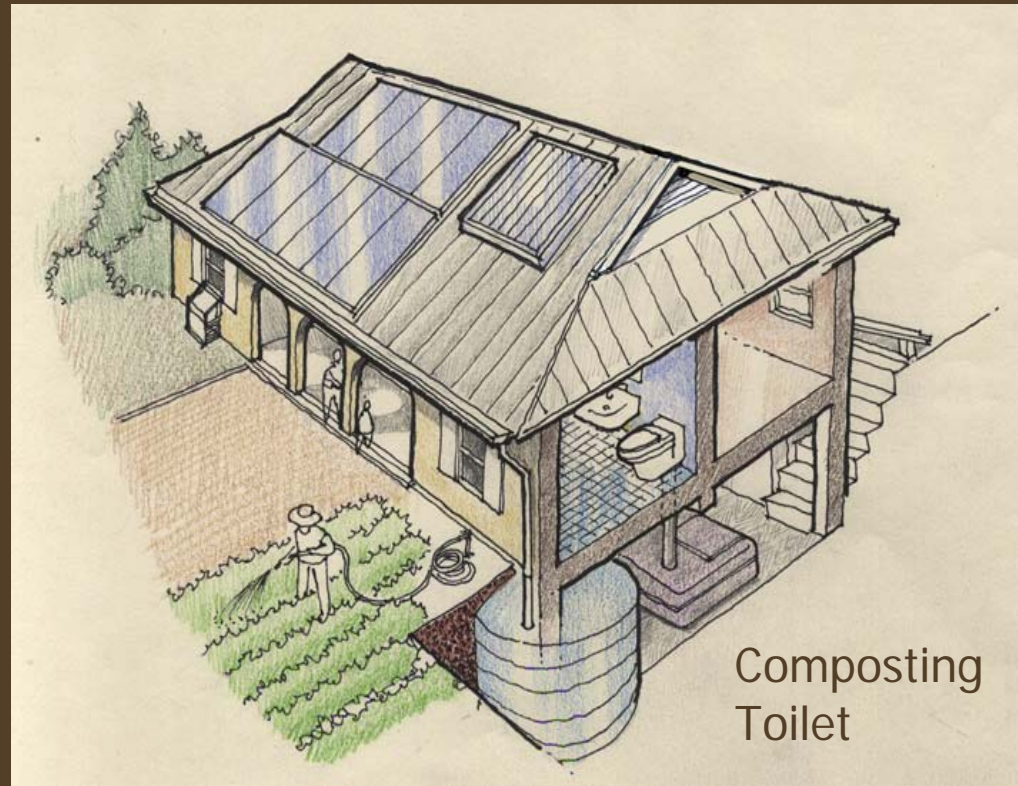
**Mulch basin**

volume per table G-2, plus 100% if possible



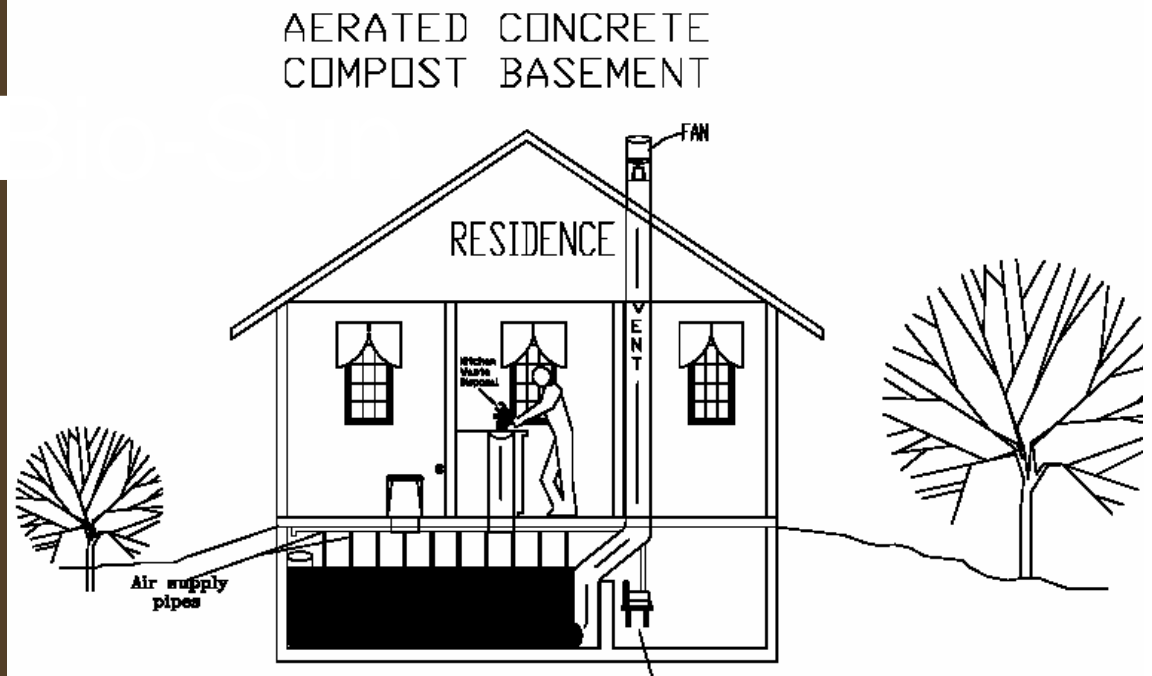
# Composting Toilet

1. Uses little or no water
2. Waste is composted to a dry, odorless fertilizer you can put directly on your garden
3. Nothing goes to the ground water
4. Completes the biological cycle

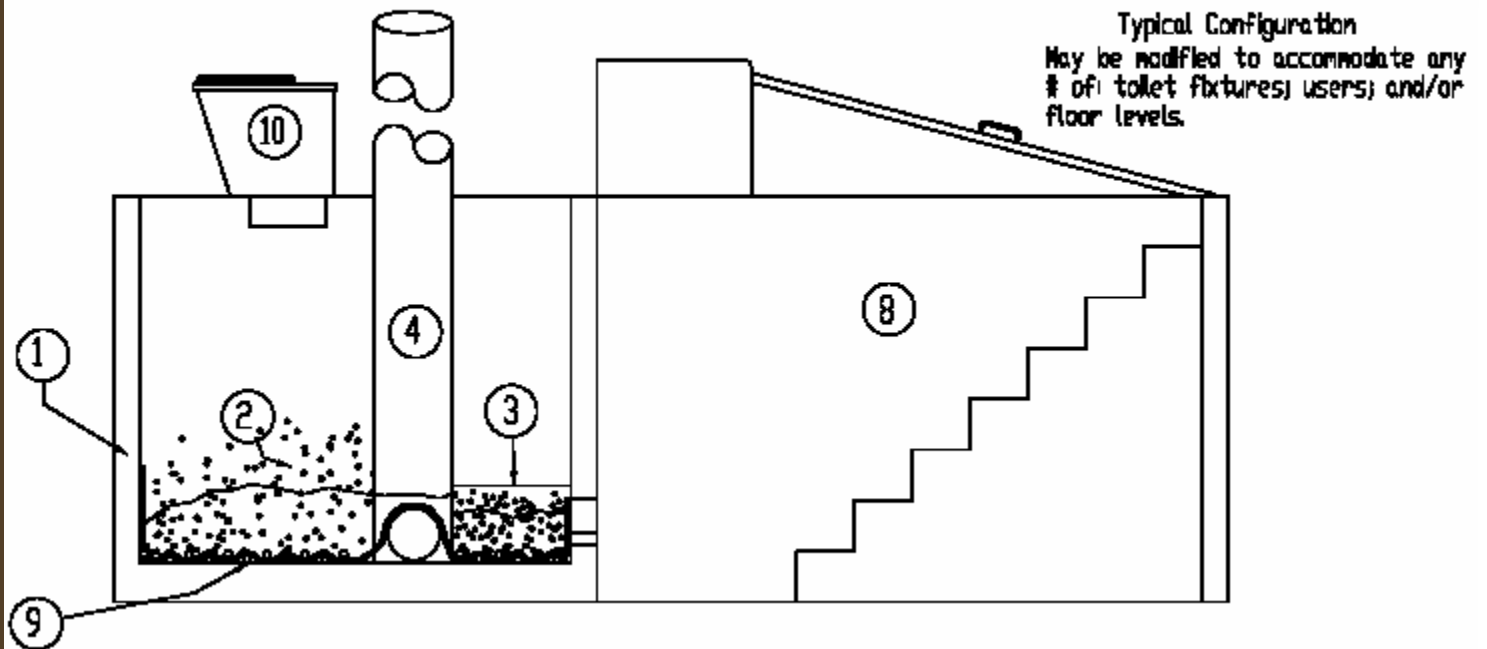


# Integrated Compost toilet system

1. Concrete basement compost chamber
2. Waste pile
3. Finishing chamber
4. Exhaust vent
9. Pressure aeration system
10. Waterless toilet

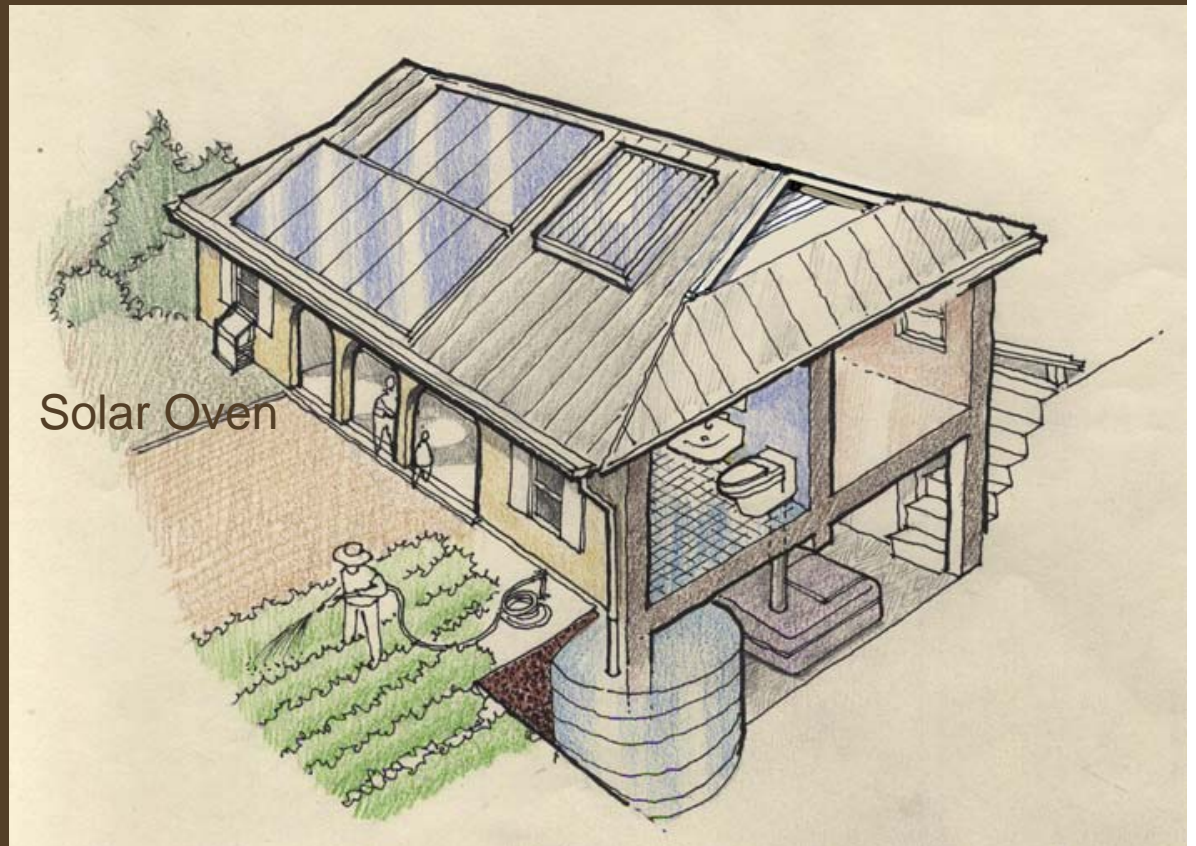


Lowest Maintenance Residential Composting Toilet





# Solar Oven



# Solar Oven

- Built in the south wall of the kitchen like a wall oven
- Stays hot all day 200-350 °f
- No fuel required
- Bake, cook stews, casseroles.....



# Earth Home <sup>TM</sup>

Self sufficient, survivable, affordable housing.

## Economics of the integrated approach

- Energy, Water and Waste system paid for by utility savings when financed with mortgage
- Earth Brick savings help offset added cost of solar
- Fast payback technologies- solar hot water and solar oven- help slow pay back – solar PV
- Overall building package is cost effective-  
*Savings are greater than mortgage payment on the added cost.*

# Earth Home <sup>TM</sup> Economics

## Monthly Cost of Home Ownership (Grenada)

### Conventional Home

- Mortgage= \$294
- utilities = \$150
  - Total \$444

\*\$40,000 at 8% for 30 years

Utilities per month,

- Electricity= \$112
- water and sewer =\$25
- propane for cooking= \$13

### Earth Home

- Mortgage= \$382
- utilities = \$28
  - Total \$410
  - *Savings \$34*

\*\$52,000 at 8% for 30 years

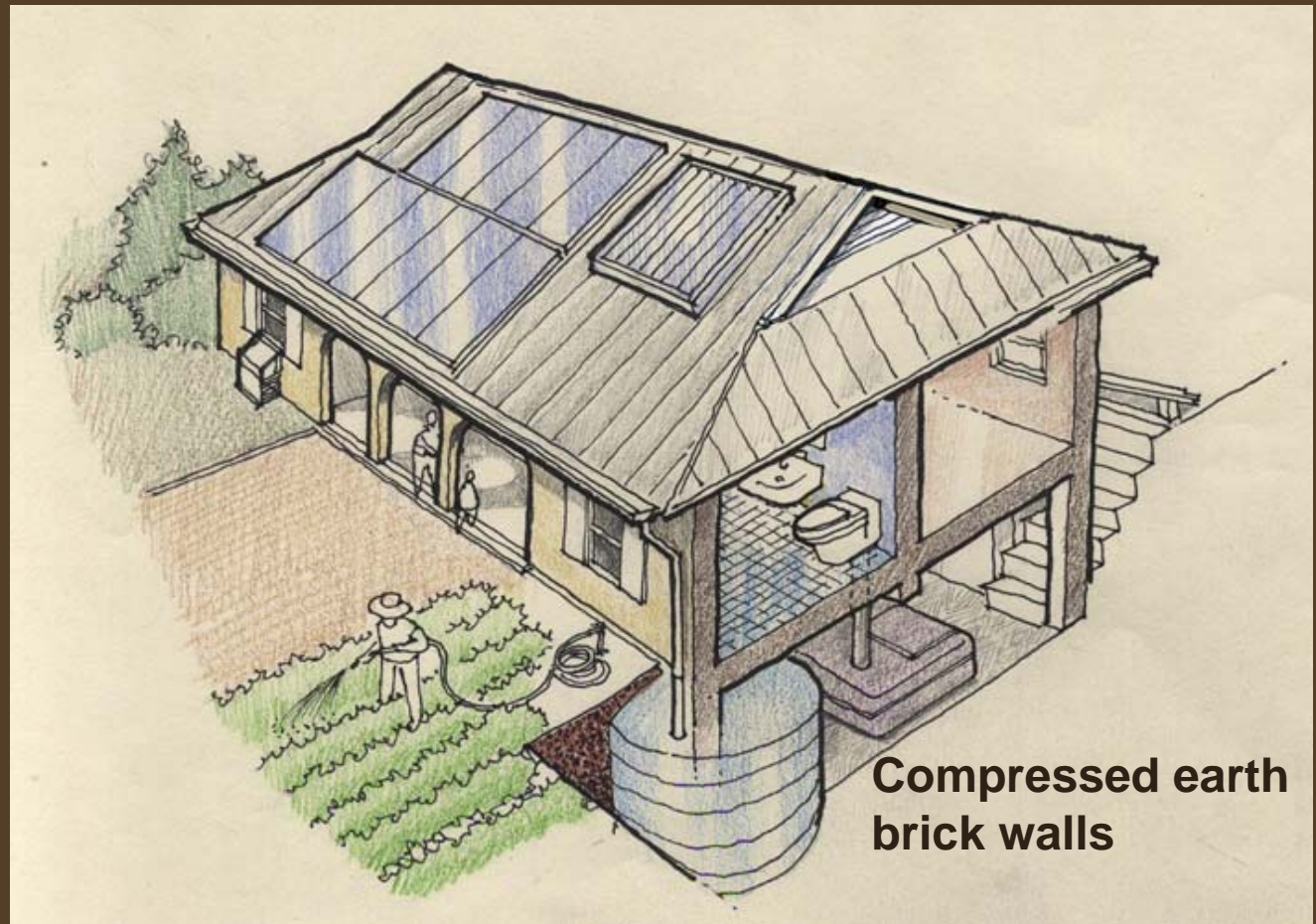
Utilities per month,

- Electricity= \$22
- water and sewer =\$0
- propane for cooking= \$6



# Compressed Earth Construction

- Use local soil to build comfortable, affordable and healthy homes
- Appropriate for both low cost homes and high end villas
- Commercial buildings and schools





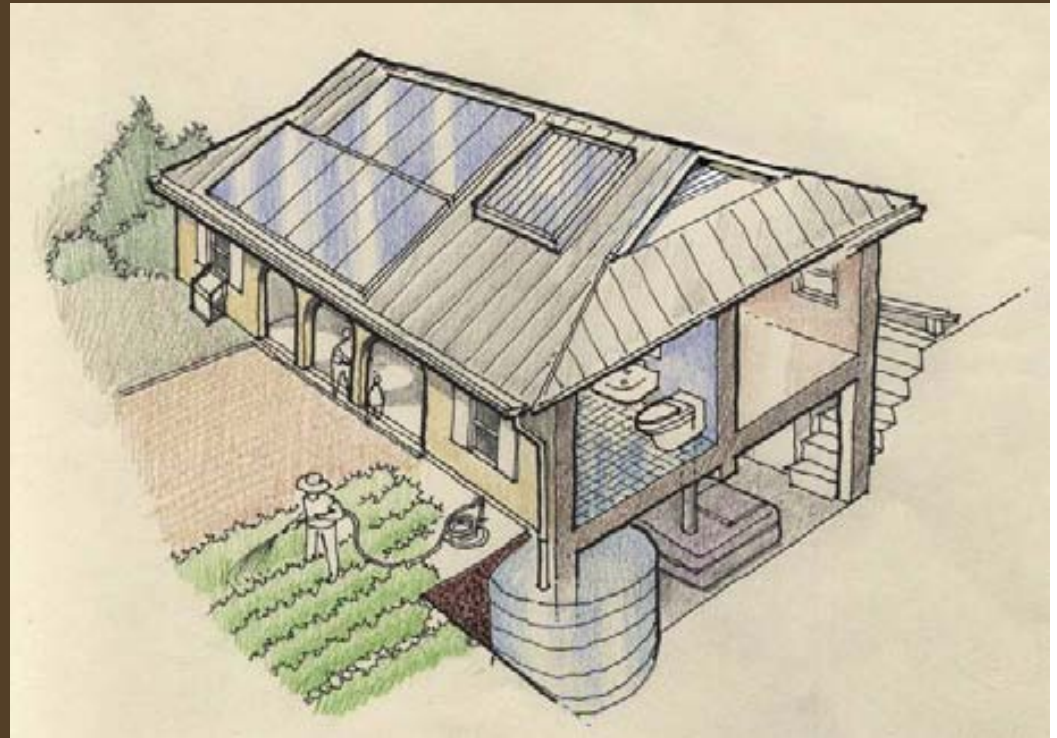
# **Earthen Structures - A Building Tradition**

## **From 3<sup>rd</sup> Century B.C.**

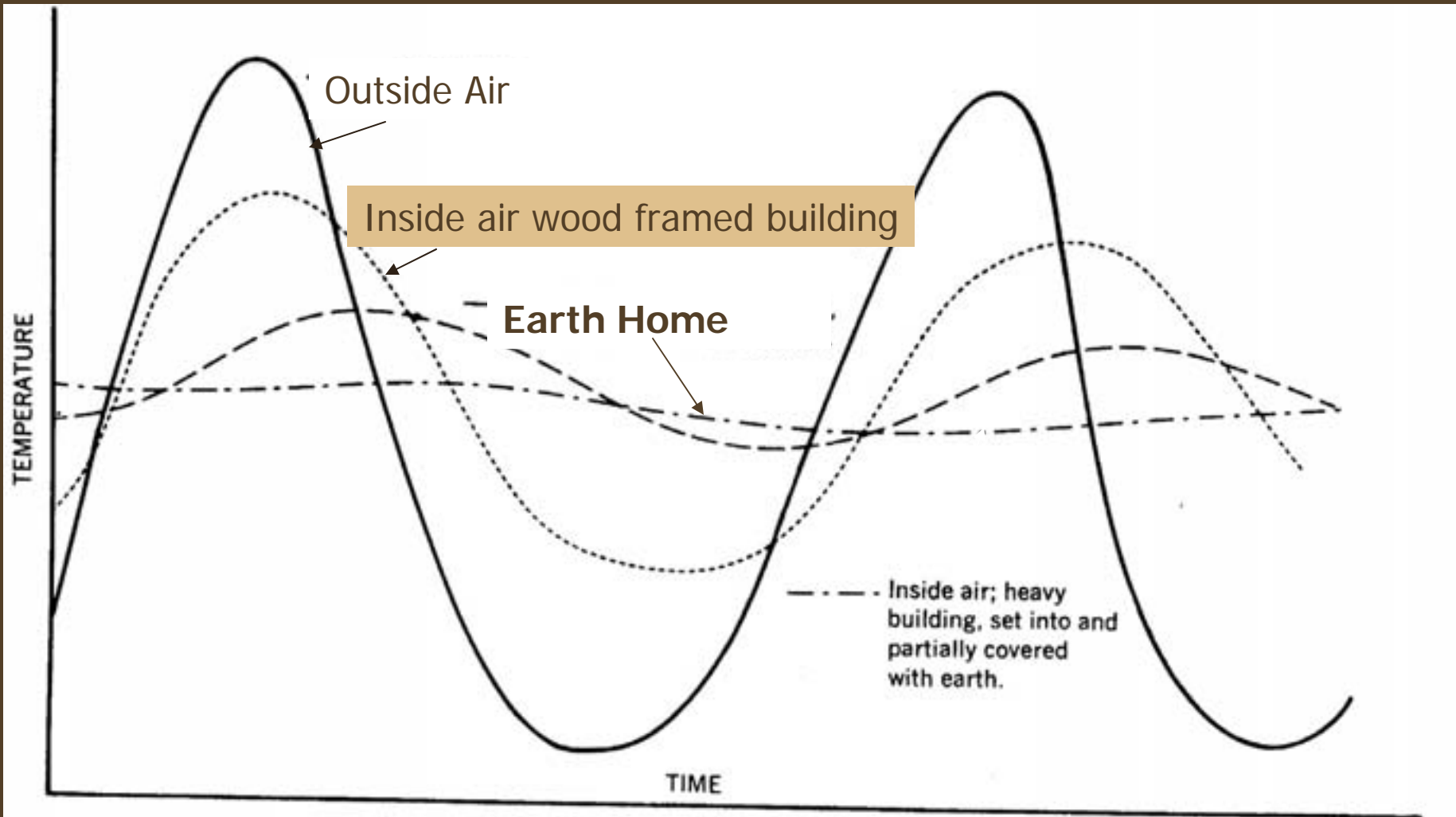
- **Origins of contemporary compressed earth block (CEB) trace back thousands of years to molded sun-dried earth bricks (“adobe”) in Iraq, Egypt, India and China.**
- **Great Wall of China is made of earth brick**
- **60-65% of world’s population live in soil based structures.**
- **A new generation of CEB Machines have significantly improved earth construction**

# Benefits

- Local materials
- Reduces imports
- Lower cost
- Owner builder friendly
- Fire proof
- Insect proof
- Hurricane proof
- Rot proof
- Natural and non toxic
- Naturally comfortable
- Breathable wall controls humidity
- High thermal mass controls temperature
- Energy efficient
- Biodegradable



# Thermal Mass Effect



# *Compressed Earth Block Technology Overview*







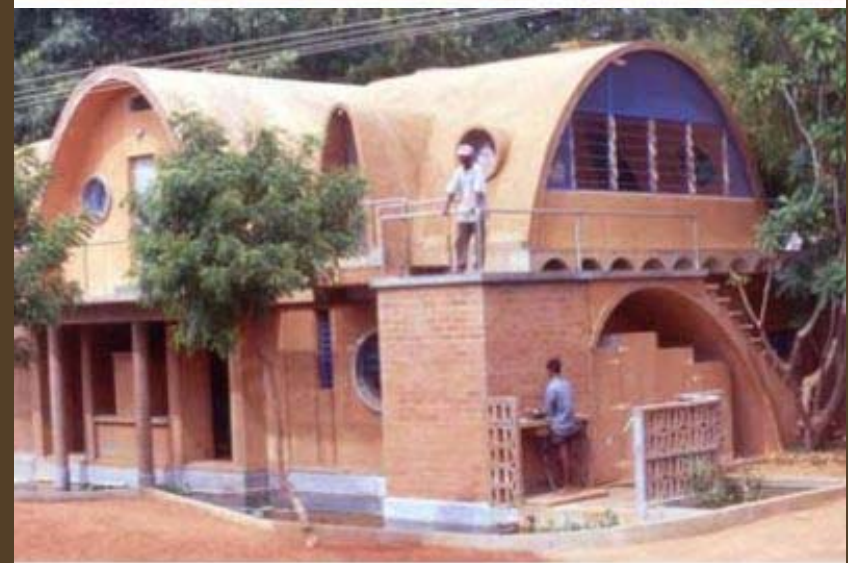
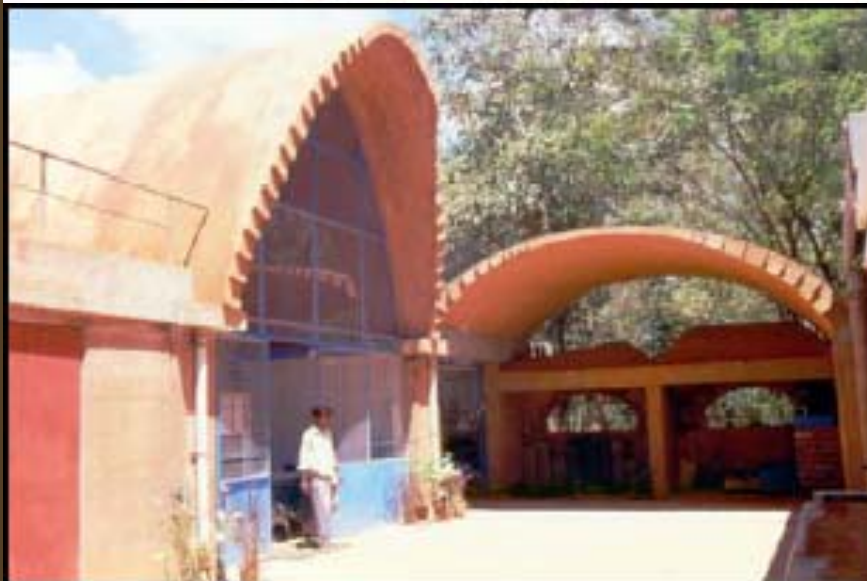
# Earth Blocks

- Our blocks are 7" X 14" X 4"
- Soil Mix
  - 30% Clay (20%-70%)
  - 65% Sand
  - 5% Lime
  - 6%-10% water content
- Slurry
  - 60% clay
  - 30% screened sand
  - 10% lime





# Earth Brick Vault Roof



Training centre completed

# Loreto Bay Mexico





# Loreto Bay Bus Stop



# Worlds Largest Earth Brick Plant Loreto Bay, Mexico





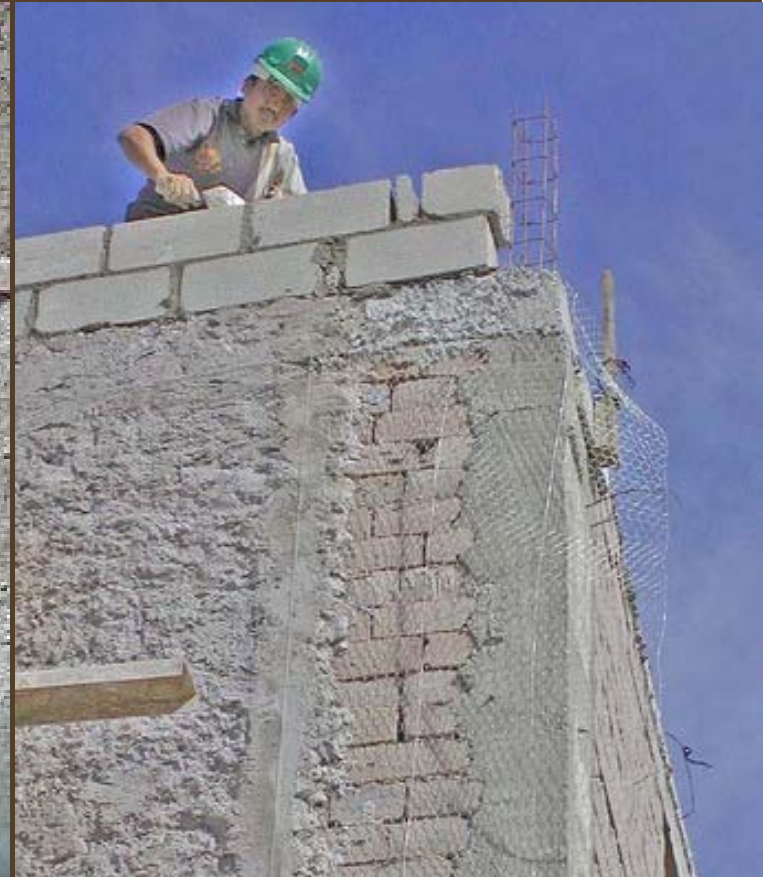
# Finished Blocks



# Stacking Bricks



# Earth Plaster





# 1,000,000<sup>th</sup> Earth Brick





# Earth Home – Habitat WV



*Cost 30% less than comparable wood frame house*

# Weingarten Home

## Hume, VA

- 7 inch Earth Block
- 4" Soy Foam R28 steady state
- Stucco
- Geothermal W-W Heat pump for heat, cooling and DHW
- ERV
- All non toxic paints, finishes and materials
- Stained concrete floor
- Passive Solar



# On Site Brick Making





# Walls Go Up



## Monitoring



## Radiant Floor



## Geothermal Well



# Window and Door Frames





# Pour Bond Beam and Corner



# Insulate and Roof











## Sandy Spring Friends School

- CEB Walls
- Passive solar
- Greenhouse
- Grey water irrigation
- Geothermal Heat pump
- Solar hot water
- PV Power w/ batteries
- Daylight skylight
- Green roof
- Local wood milled on site
- Natural and non toxic everything





# Putting it All Together Sustainable Communities

# Sustainable Community

- Zero energy/ self sufficient Homes
- Community sewage treatment
  - Grey water reuse system for irrigation
  - Composting for fertilizer
- Community Gardens
  - food
  - ornamentals
  - small business

# Sustainable Community (continued)

- Small Business Support
  - Gardens, grocery co-op, restaurants
  - Business support services- Fax, computer, secretary, teleconferencing
  - Services
- Basic services within walking or biking distance
- Easy access to mass transit
- Town Center

# Low Cost Housing, South Africa

*International low-cost housing and sustainable community development*



***BEFORE***



***After***

# Low Cost Housing, South Africa

*International low-cost housing and sustainable community development*





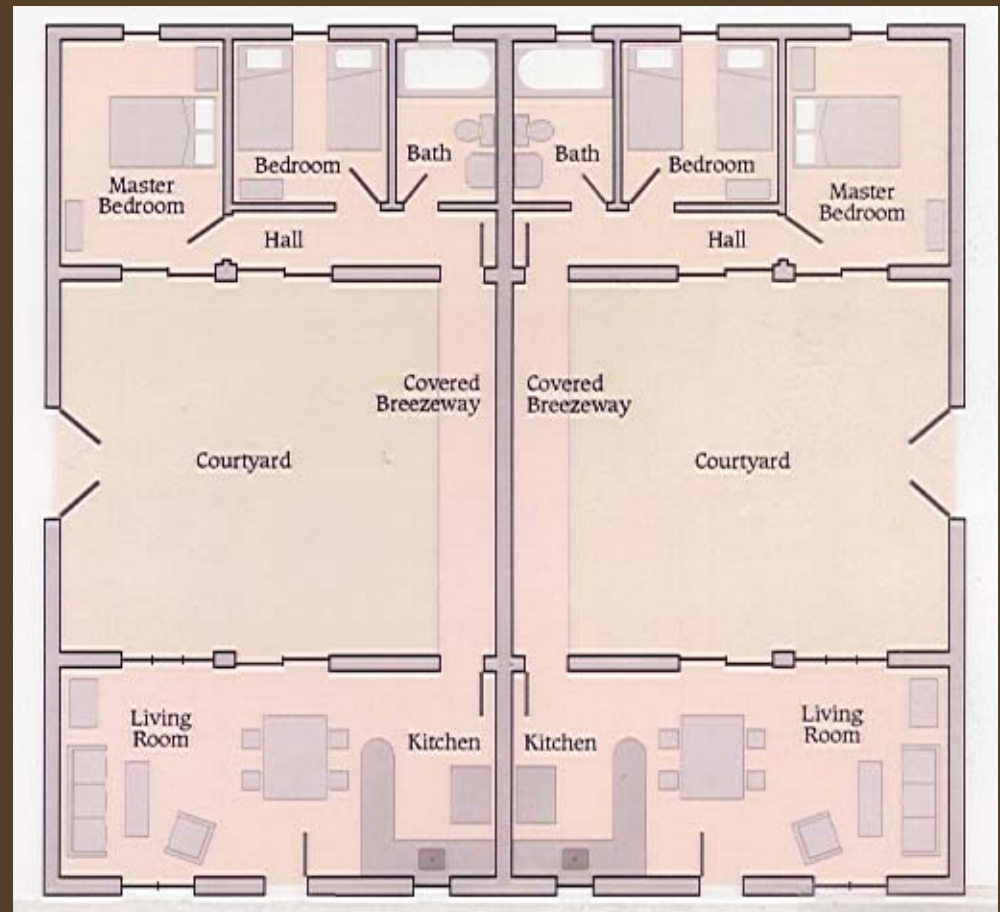
# Low Cost Housing, South Africa

*International low-cost housing and sustainable community development*

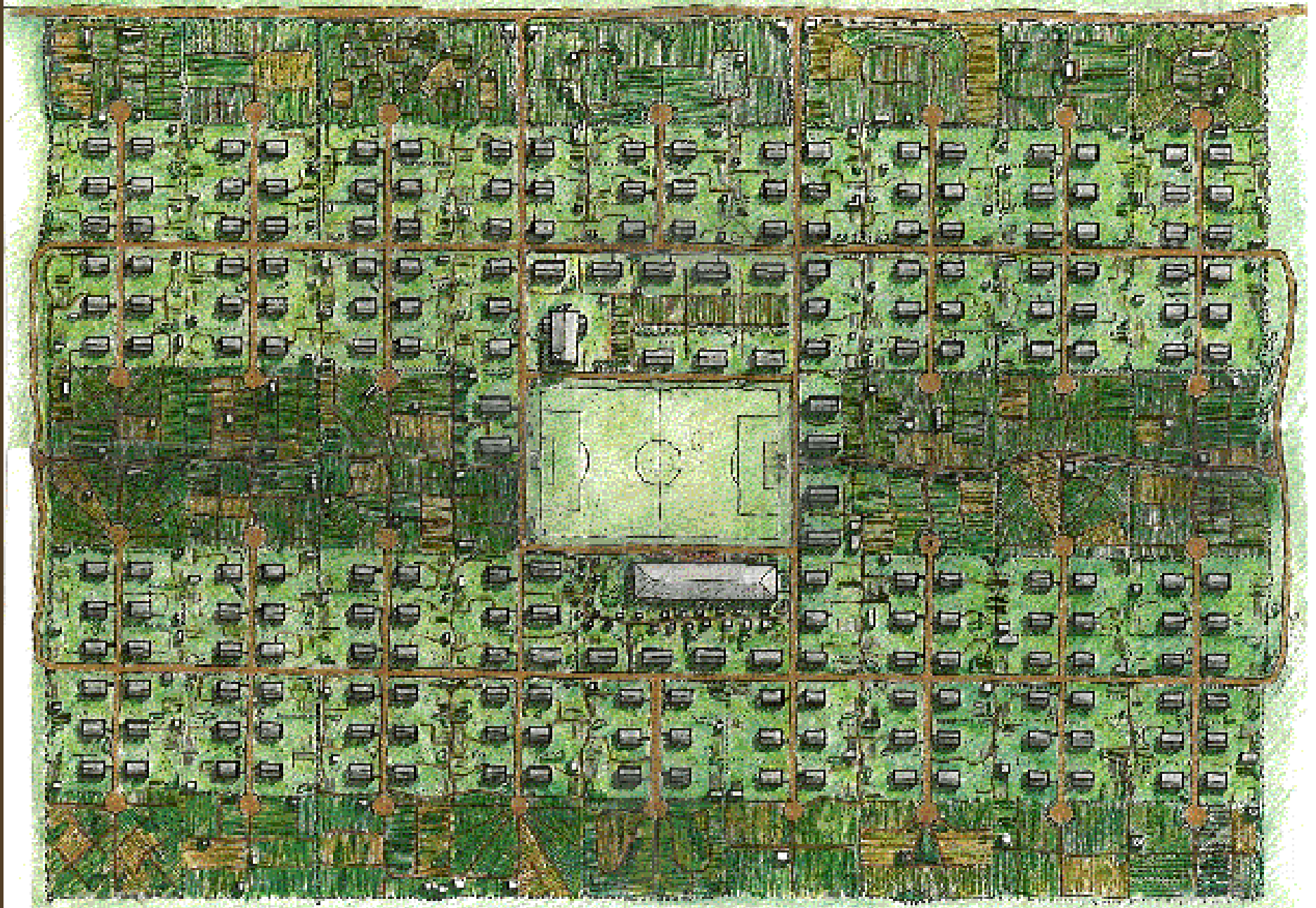


# Low Cost Housing, South Africa

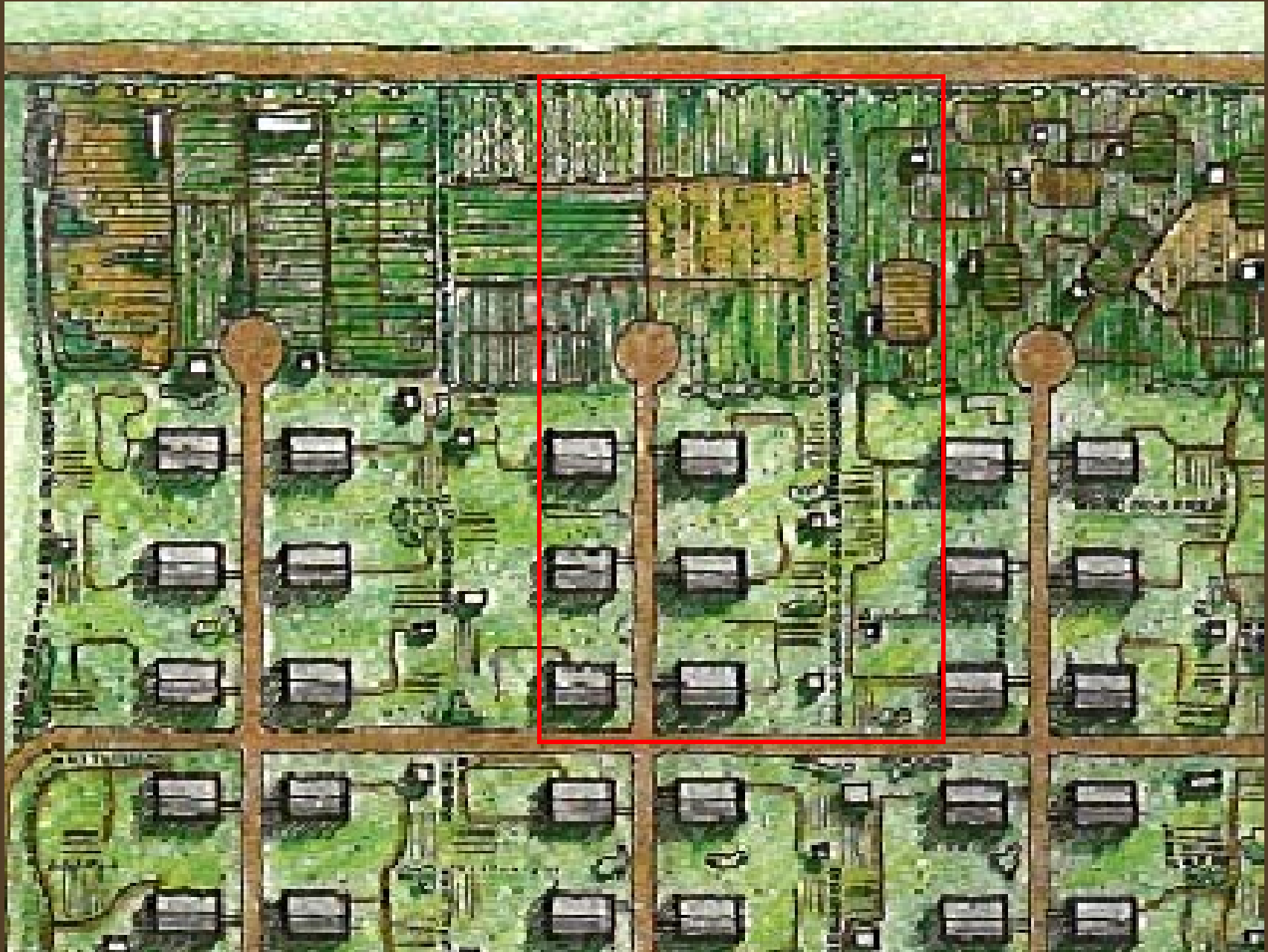
*International low-cost housing and sustainable community development*



# Ugie, SA Solar Village Plan



# Shared Garden Clusters





# Town Center Plan



# Longju Model Sustainable Village Guanghan, China





# Sustainable Village Design





Temple

Agriculture Fields

Animal Barns and  
BioGas Plant

Existing Natural  
Village

Agriculture Fields

Existing Tea  
House

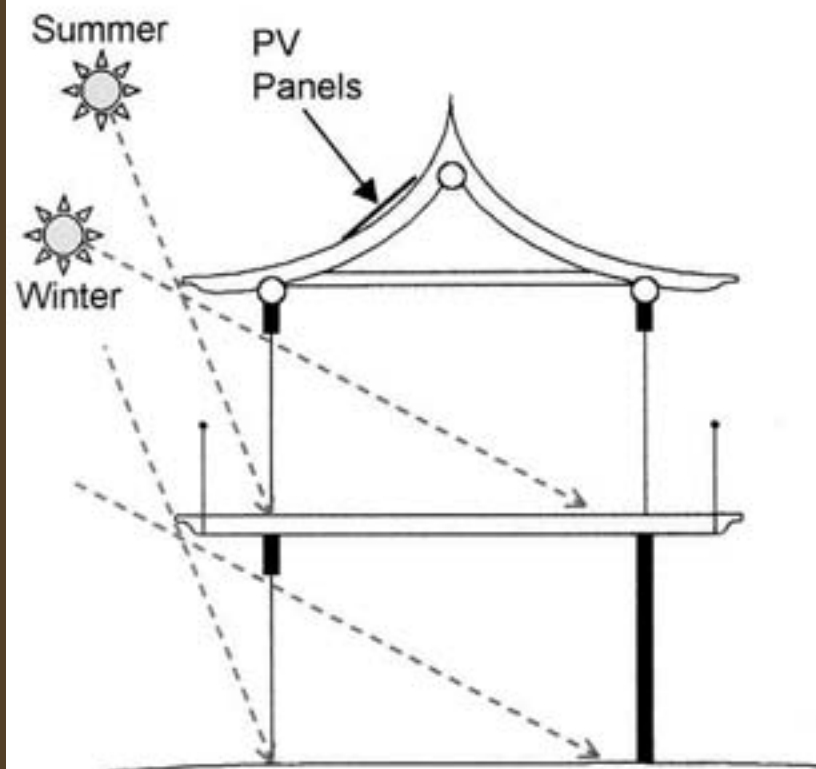
New  
Community  
Center

Proposed Tea  
House

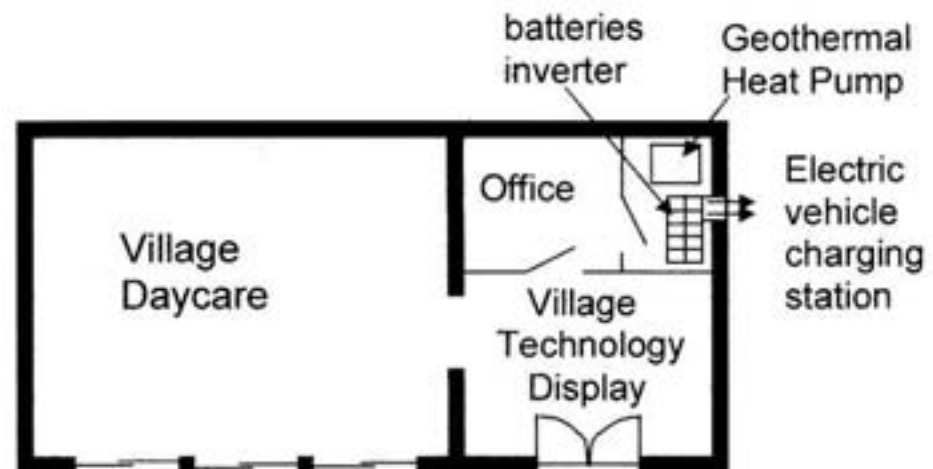
New Housing  
and Shopping

River

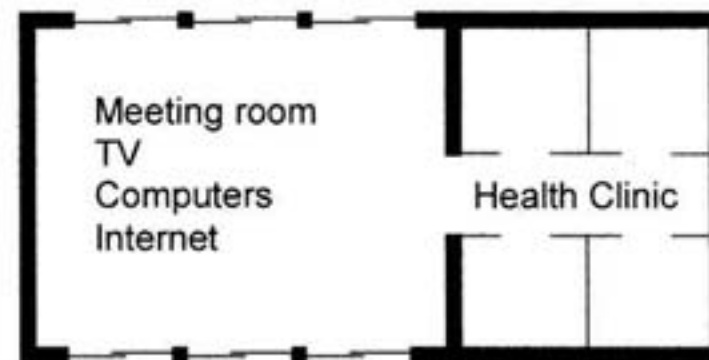




**Guanghai  
Community Center**

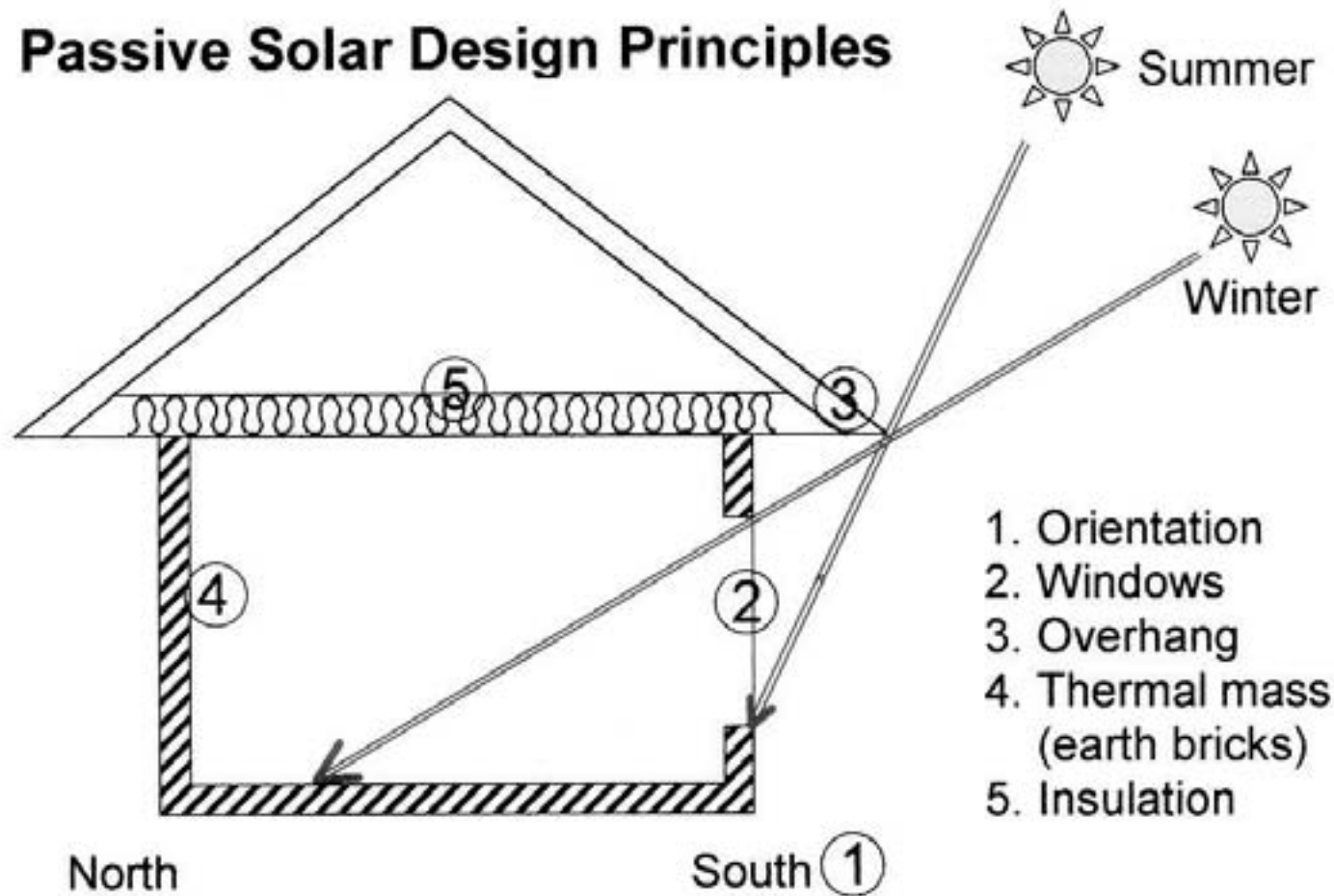


**First Floor**



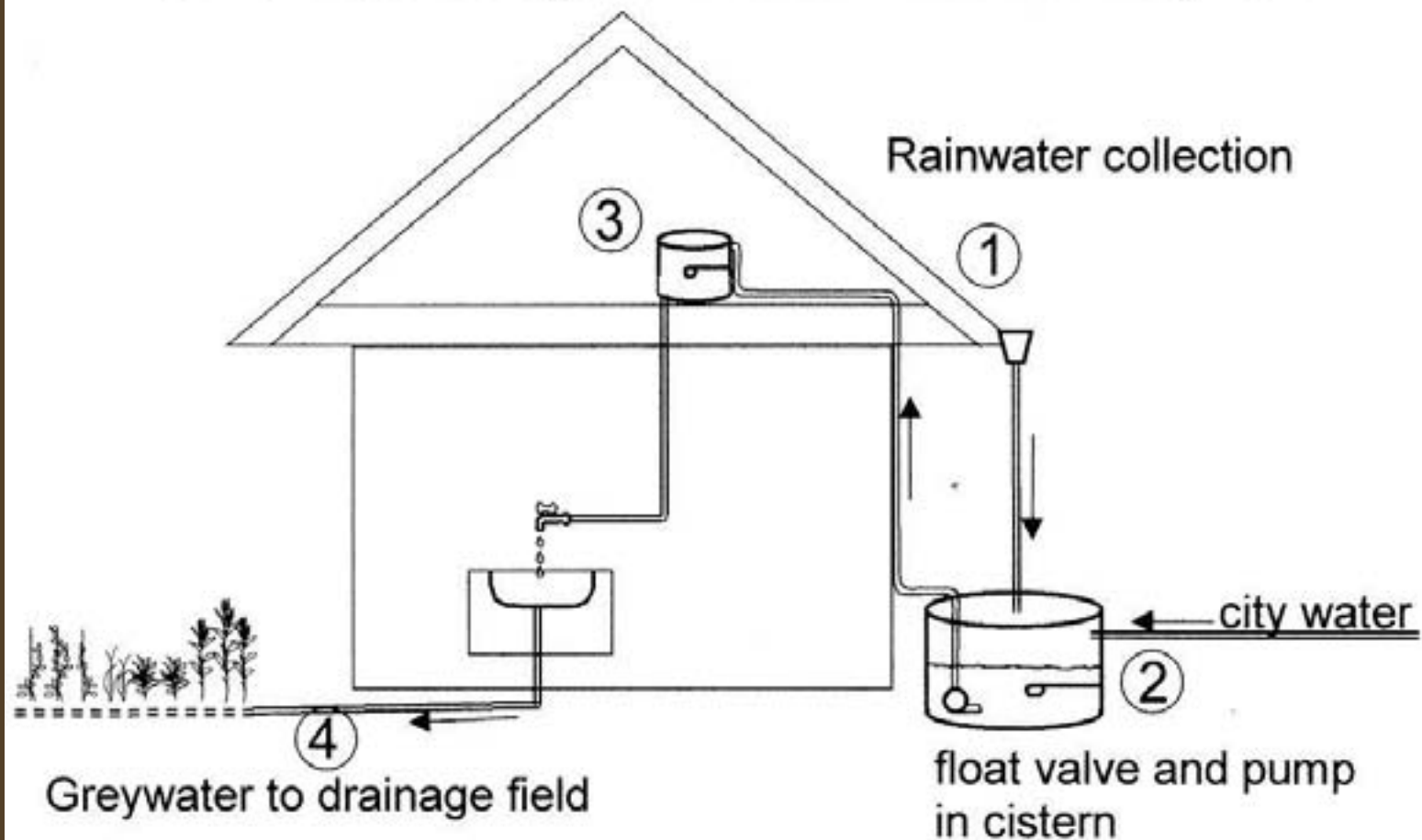
**Second Floor**

## Passive Solar Design Principles



1. Orient most window glass to South, less toward East and West, little toward the North.
2. Use energy-efficient windows.
3. Design overhang to shade summer sun but let winter sun in.
4. Build walls of high mass materials to store thermal energy.
5. Use good ceiling insulation.

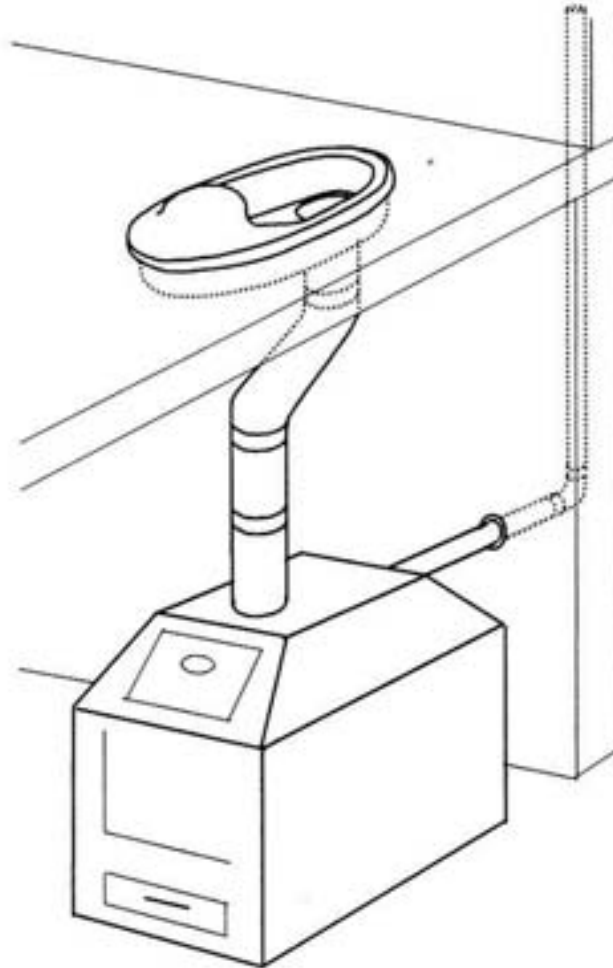
## Schematic Design of Water/ wastewater System



1. Gutters drain rainwater to cistern.
2. Float valve in cistern controls city water to maintain cistern at minimum of 1/3 full (if no rain). Top 2/3 of tank is for rainwater.
3. Attic tank filled by submersible pump in cistern and controlled by float valve in attic tank.
4. Sink drain water to drainfield under house garden.

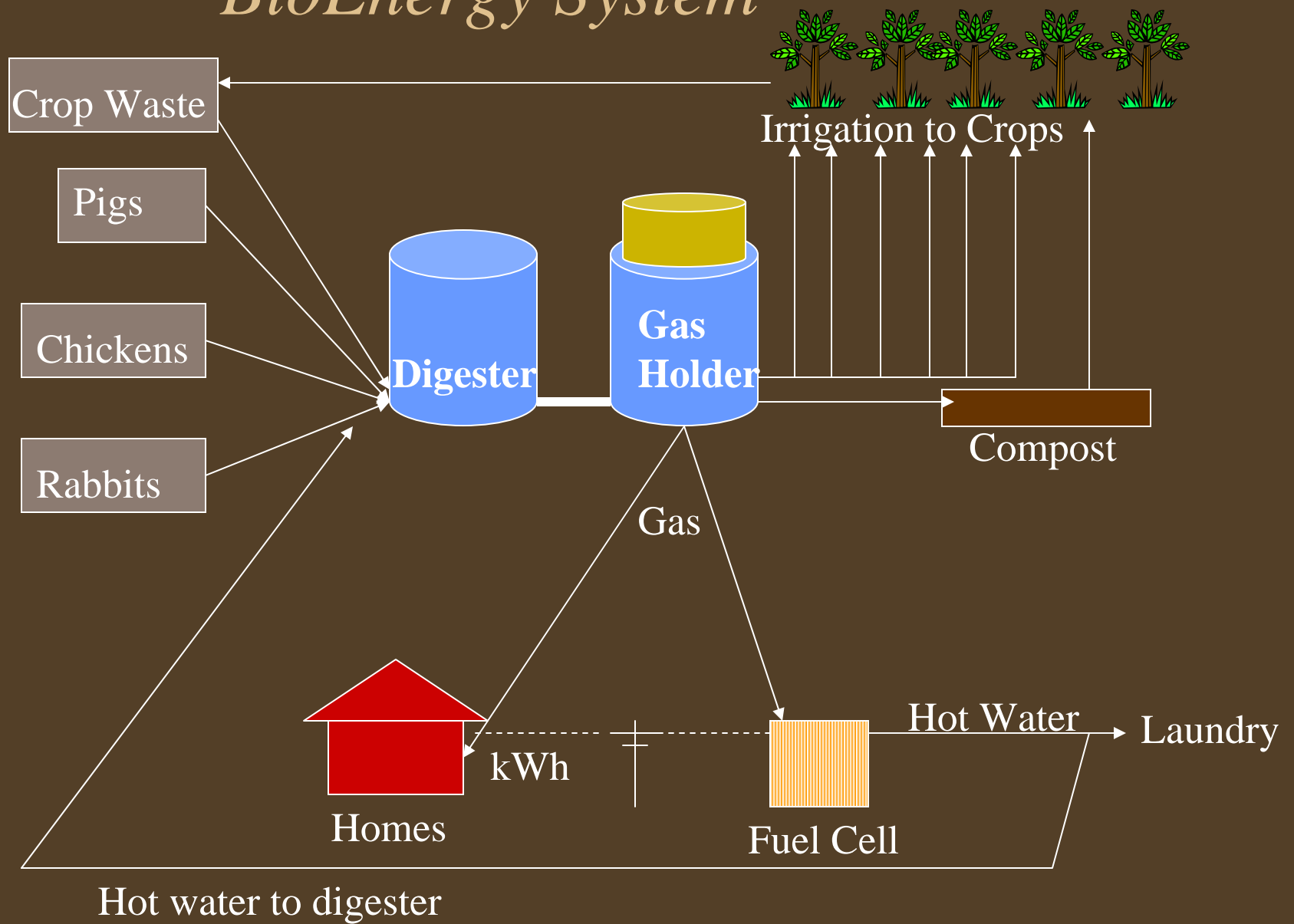


## Composting Toilet



- Waste drops into composter below.
- Composted waste is removed from bottom drawer (once a year) — ready for use on garden.
- No odor—gases exhausted to roof.

# BioEnergy System



# Biogas Power Plant



Biogas Digester



Biogas Holder



Biogas Engine



Generators







## Cooking with Biogas



# *Sustainable Beijing Olympic Village*

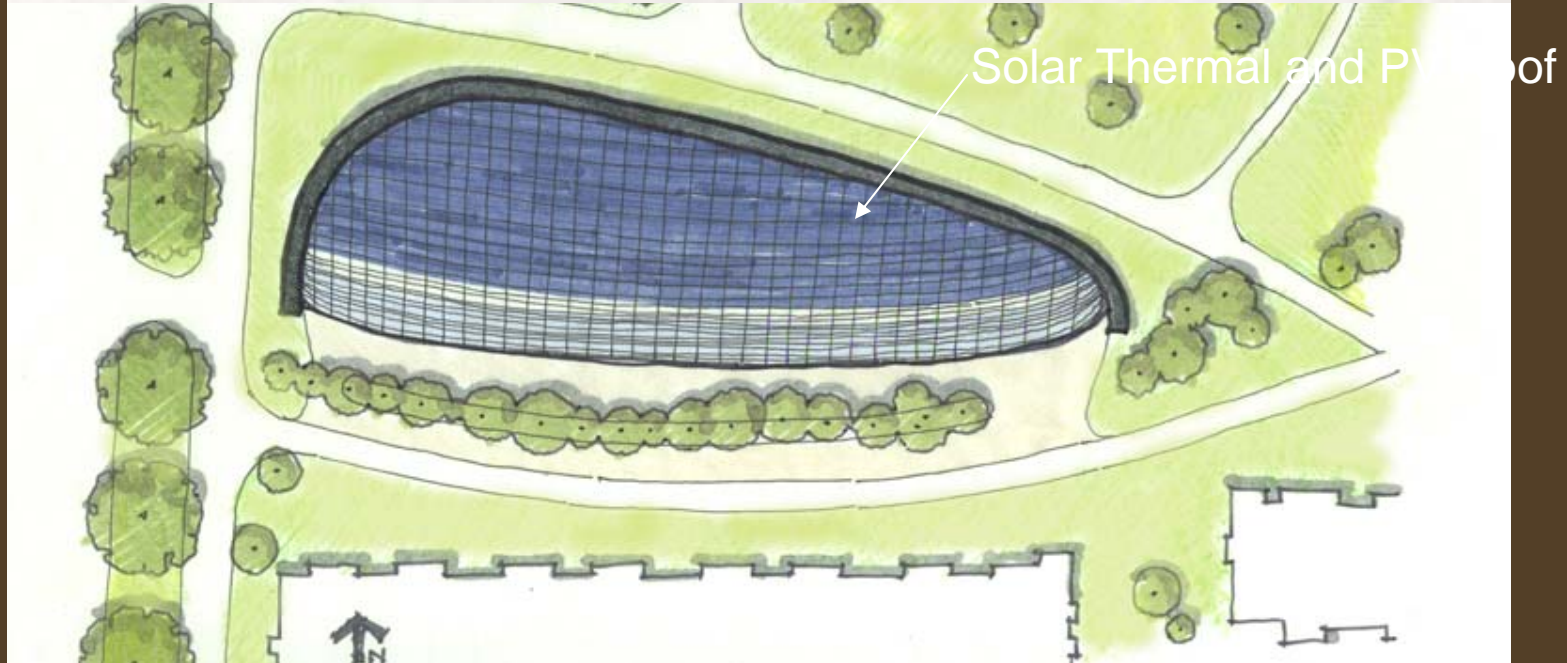
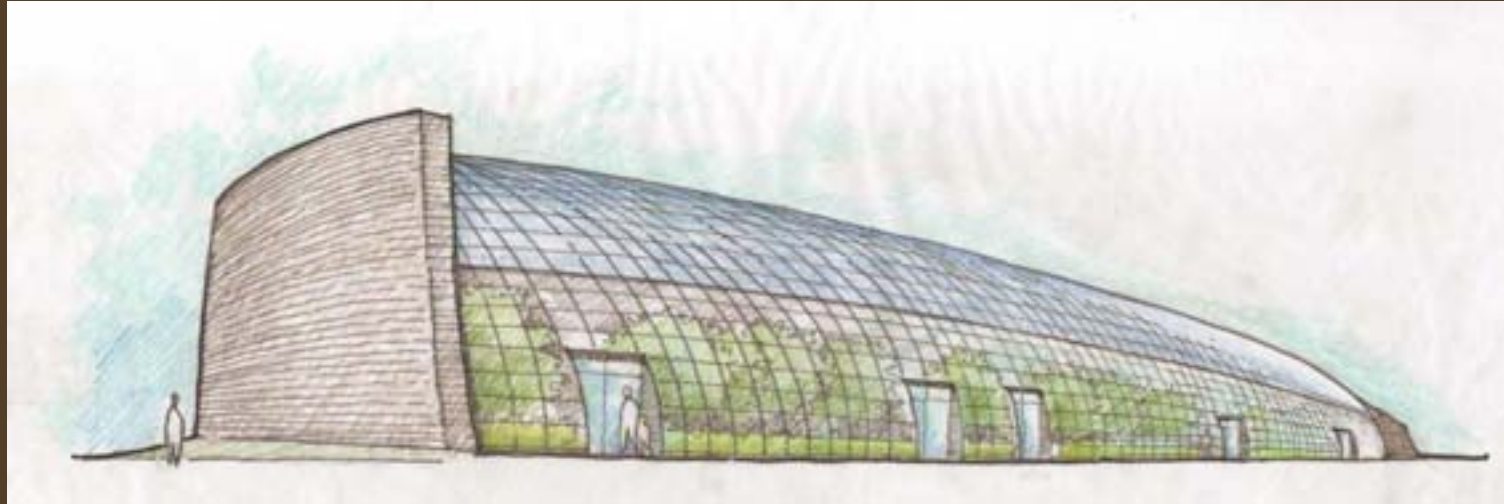
Objective: Make the Olympic Village a Model Sustainable Development for future urban development in China using state-of-the-art planning, design and technology. This will demonstrate all three themes of the 2008 Olympics- High Tech, Green and the Peoples Olympics



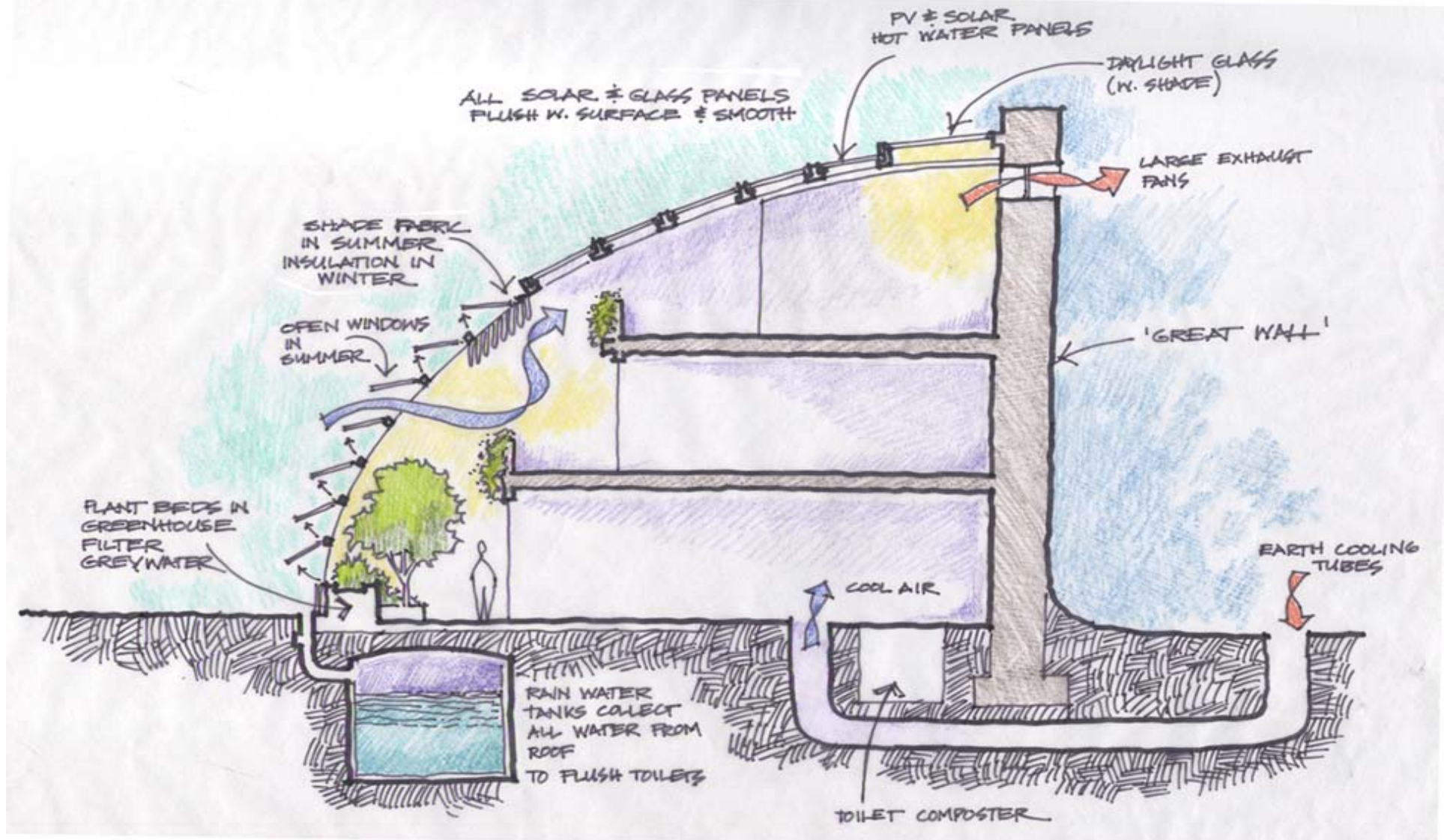


# Winter Garden School

## A Living Building for the Beijing Olympics



# Full Section Showing Summer Operation





# Conclusions

- We have abundant renewable natural resources and the potential for a 100% renewable based economy
- Self Sufficiency is possible at all levels and should be our goal
- Economic development and job creation potential is huge
- Environmental and social benefits are clear

Self sufficiency through the development of our natural renewable resources gives people, communities and nations true freedom and unlimited opportunity to grow and prosper.



# Thank You



John Spears